CLAIMS

What is Claimed is:

1. A method for identifying impurities in a cryogenic liquid, comprising the steps of:

measuring the absorption spectrum of the cryogenic liquid;

measuring the absorption spectrum of at least one impurity alone;

passing a cryogenic liquid sample into a flow cell;

measuring the absorption spectra of said cryogenic liquid sample while said cryogenic liquid sample is within said cell;

comparing said cryogenic liquid sample absorption spectra to said cryogenic liquid and impurity spectra; and

confirming the presence of said sample absorption spectrum associated with said impurity.

2. The method of Claim 1, wherein maximum pressure drop across said flow cell is in the range of 0.5 to 5.0 lb./in.^{2}.

3. The method of Claim 2, wherein said maximum pressure drop across said flow cell is in the range of 0.75 to 1.5 lb./in.^{2}.

4. The method of Claim 1, wherein said absorption spectra of said cryogenic liquid, impurity and cryogenic liquid sample is measured by passing light in the infrared region through said cryogenic liquid, impurity and cryogenic liquid sample.

5. The method of Claim 4, wherein said light to be passed through said cryogenic liquid, impurity and cryogenic liquid sample is scanned in the range of 900 to 2200 nanometers.

6. The method of Claim 1, wherein said cryogenic liquid comprises a liquid fluorinated hydrocarbon selected from the group consisting of a hydrofluorocarbon, chlorofluorocarbon, hydrofluoroalkane and derivatives thereof.

7. The method of Claim 1, wherein said impurity comprises a material having at least a CO, NH, OH, CH and SH bond.

8. The method of Claim 1, wherein said impurity comprises a material having a vibration energy in the range of approximately 3 x 10e14-12e14Hz.

9. The method of Claim 1, wherein said impurity comprises a volatile organic.

10. A method for identifying impurities in a cryogenic liquid, comprising the steps of:

measuring the absorption spectrum of the cryogenic liquid by passing light in the infrared region through the cryogenic liquid, said cryogenic liquid absorption spectrum having a first reference energy;

measuring the absorption spectrum of at least one impurity alone by passing light in the infrared region through said impurity;

passing a cryogenic liquid sample into a flow cell, wherein the maximum pressure drop of said cryogenic liquid sample across said flow cell is in the range of 0.75 to 1.5 lb/in.^{2};

measuring the absorption spectra of said cryogenic liquid sample by passing light in the infrared region through said cryogenic liquid sample while said cryogenic liquid sample is within said cell;

comparing said cryogenic liquid sample absorption spectra to said cryogenic liquid and impurity spectra;

confirming the presence of said cryogenic liquid sample absorption spectrum associated with said impurity, said sample absorption spectrum associated with said impurity having a second reference energy; and

determining the concentration (C) of said impurity in said cryogenic liquid sample by the following relationship,

$$kC = \log \frac{\text{second reference energy}}{\text{first reference energy}}$$

where k is a fixed proportionality constant.

11. The method of Claim 10, wherein said flow cell provides substantially continuous flow of said cryogenic liquid sample through said flow cell.

12. The method of Claim 10, wherein said maximum pressure drop across said flow cell is approximately 1.0 lb./in.^{2}.

13. The method of Claim 10, wherein said light to be passed through said cryogenic liquid, impurity and cryogenic liquid sample is scanned in the range of 900 to 2200 nanometers.

14. The method of Claim 10, wherein said cryogenic liquid comprises a liquid fluorinated hydrocarbon selected from the group consisting of a hydrofluorocarbon, chlorofluorocarbon, hydrofluoroalkane and derivatives thereof.

15. The method of Claim 10, wherein said impurity comprises a material having at least a CO, NH, OH, CH and SH bond.

16. The method of Claim 10, wherein said impurity comprises a material having a vibration energy in the range of approximately 3 x 10e14-12e14Hz.

17. The method of Claim 10, wherein said impurity comprises a volatile organic.

18. A method for identifying impurities in a cryogenic liquid at multiple locations within a production environment, comprising:

measuring the absorption spectrum of the cryogenic liquid by passing light in the infrared region through said cryogenic liquid, said cryogenic liquid absorption spectrum having a first reference energy;

measuring the absorption spectrum of at least one impurity alone by passing light in the infrared region through said impurity;

passing a cryogenic liquid sample into each of a plurality of flow cells, wherein the maximum pressure drop of said samples across said flow cells is in the range 0.5 to 5.0 lb./in.^{2}, each of said flow cells corresponding to a location within the production environment;

selectively measuring the absorption spectra of said cryogenic liquid samples by passing light in the infrared region through said cryogenic liquid samples while said samples are contained within flow cells;

comparing said cryogenic liquid sample absorption spectra to said cryogenic liquid and impurity spectra;

confirming the presence of said sample absorption spectrum associated with said impurity, said sample absorption spectrum associated with said impurity having a second reference energy; and

determining the concentration (C) of said impurity in said cryogenic liquid sample at each of said cell locations by the following relationship,

$$kC = \log \frac{\text{second reference energy}}{\text{first reference energy}}$$

where k is a fixed proportionality constant.

19. The method of Claim 18, wherein maximum pressure drop across said flow cells is in the range of 0.75 to 1.5 lb./in.^{2}.

20. The method of Claim 18, wherein said maximum pressure drop across said flow cells is approximately 1.0 lb./in.^{2}.

21. The method of Claim 18, wherein said light to be passed through said cryogenic liquid, impurity and cryogenic liquid samples is scanned in the range of 900 to 2200 nanometers.

22. The method of Claim 18, wherein said cryogenic liquid comprises a liquid fluorinated hydrocarbon selected from the group consisting of a hydrofluorocarbon, chlorofluorocarbon, hydrofluoroalkane and derivatives thereof.

23. The method of Claim 18, wherein said impurity comprises a material having at least a CO, NH, OH, CH and SH bond.

24. The method of Claim 18, wherein said impurity comprises a material having a vibration energy in the range of approximately 3 x 10e14-12e14Hz.

25. The method of Claim 18, wherein said impurity comprises a volatile organic.

26. A system for sampling a plurality of cryogenic liquid samples having a cryogenic liquid base, comprising:

a source of cryogenic liquid sample;

conduit means in flow communication with said source of cryogenic liquid sample for transferring said cryogenic liquid sample to a plurality of locations;

at least one flow cell in communication with said conduit means, said flow cell adapted to maintain a maximum pressure drop across said cell in the range of 0.5 to 5.0 lb./in.^{2};

analyzer means for respectively measuring the absorption intensity of the base cryogenic liquid, target impurity and cryogenic liquid sample by separately passing infrared light through the base cryogenic liquid, impurity and cryogenic liquid sample; and

means for determining the concentration of said impurity.

27. The system of Claim 26, wherein said maximum pressure drop across said cell is in the range of 0.75 to 1.5 lb./in.^{2}.

28. The system of Claim 26, wherein said system comprises a plurality of flow cells.

29. The system of Claim 28, wherein said system includes control means in communication with said analyzer means to direct said analyzer means to conduct said measurement of said cryogenic liquid sample proximate a respective one of said flow cells.